OTS: 60-31,182

JPRS: 3298

24 May 1960

GEOPHYSICAL PROSPECTING IN THE PEOPLE'S REPUBLIC OF CHINA

By A. G. Ivanov

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.
(Price: $0.50)

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

F O R E W O R D

This publication was prepared under contract by the UNITED STATES JOINT PUBLICATIONS RESEARCH SERVICE, a federal government organization established to service the translation and research needs of the various government departments.

JPRS: 3298

CSO: 3853-D

GEOPHYSICAL PROSPECTING IN THE PEOPLE'S REPUBLIC OF CHINA

/Following is a translation of an article by A. G. Ivanov in Vestnik Akademii Nauk SSSR (USSR Academy of Sciences Review), Vol. XXIX, No. 11, Moscow 1959, pages 74-78./

Every year investigations in geophysics, an important branch of great practical significance, are developing more extensively in the People's Republic of China. In particular, much attention is being devoted to the development of seismic and electrical prospecting methods. A. M. Yepinat'yeva, A. G. Ivanov, and I. P. Kosminskaya, personnel of the Institute of Physics of the Earth, USSR Academy of Sciences, were sent to China to participate in compiling the plan for scientific research work in this field by the Institute of Geophysics, Academy of Sciences of the People's Republic of China.

The group of specialists from the Chinese and USSR academies of sciences, which was headed by Professor Ku Kung-hsü, included, in addition to the Soviet scholars, Professor Ch'ing Hsin-lin and the young Chinese geophysicists, Lin Jêng-yen and Li Kuei-chen, who received their higher education in the USSR.

When one travels along the roads in China, a great panorama of the all-conquering enthusiasm of the Chinese people for labor appears everywhere: in the huge rice fields, and at the construction sites of new factories, plants, bridges, railroads, etc. At nightfall one sees a whole sea of fire in every direction: hundreds of thousands of small furnaces for smelting ore into metal operate day and night (in addition to the new, large industrial blast furnaces which have been built). In many places one can see posters and slogans with the appeals: Catch up to England in the production of the basic types of products much sooner than in 15 years! Build socialism according to the principle: more, faster, better and cheaper! Think more boldly, speak more boldly, accomplish more boldly and faster!

For one and one half months we traveled around the people's Republic of China, covering more than 10,000 kilometers, and visited the operating petroleum prospecting expenditions of the Ministry of Petroleum Industry and the Ministry of Geology of the People's Republic of China in the Tsaidam depression, in the region of Yumen city, in Szechwan Province and on the Northern China plain. At each expedition we familiarized ourselves with the conditions of the geophysical work and with the primary and final data, discovered and discussed the main methodological difficulties with the expedition personnel, and shared the experience of USSR geophysical research; joint final technical meetings were held everywhere, and the chief tasks for scientific research were formulated as much as this was possible.

The Tsaidam depression is at a high altitude and is located between Nan-shan and Kwen-lun mountains; the depression is 120,000 square kilometers in area and is an average 2,800 meters above sea level. The conditions for geophysical work are extremely difficult: there are many salt marshes and lakes and a considerable part of the territory is desert. Soviet specialists took part in the development and study of this region, begun in 1954.

Such remarkable petroleum resources were discovered among the mineral resources of the Tsaidam depression that it is deservedly called "the sea of oil." Petroleum has been noted at considerable depths. Some wells give gushers with a yield of hundreds of tons of petroleum a day.

The stratum of sedimentary rock is conjectured to reach 10-15 kilometers in depth. Exploitation of the deposits will begin in the next 1-2 years, after lines of communication are prepared to take out the petroleum.

Geophysical investigations by the methods of gravimetry, aeromagnetic prospecting, and electrical and seismic prospecting have been given quite a lot of attention. The geological and geographic conditions of work in the Tsaidam depression are complicated by a change in the lithologic composition of the rock between the periphery and the center of the depression and by the presence of a series of large and small faults in the sedimentary rock stratum. The necessity of prospecting the buried structures under these conditions (with a study of the geological structure to a depth of 8-15 kilometers) forces the geophysicists to seek out the most modern methods. In particular, they are already using a method of deep seismic sounding, developed in the USSR, and prospecting by the telluric current method.

From the Tsaidam depression we traveled in cars 1,000 kilometers back to the city of Yumen, where we familiarized ourselves with the work of the geophysical groups of the Yumen Petroleum Administration. Here we received good confirmation of the mutual value of the exchange of experience between Soviet and Chinese geophysicists. In particular, this became evident when studying the data from sesismic prospecting with the refraction correlation method (KMPV). It turned out that when the KMPV data were interpreted in the responsible sections, multiple waves were interpreted as single waves, leading to an erroneous conclusion as to the presence of a structure. Joint examination of the data, with consideration taken of USSR experience, made it possible to clarify the error and point out the direction of further work with this method. At the same time we ourselves become familiar with new data for difficult conditions which also are met in geophysical work in the USSR.

The relatively complicated geological geophysical conditions in this region (the presence at the surface of a nonhomogeneous stratum of conglomerated ranging in depth from a few meters to 900 meters; the existence of considerable weathered layers between the different layers of sedimentary rock and at the surface of the crystalline base; etc.) makes it necessary to conduct strictly complex interpretation of all geophysical and geological data. The geophysicists of the Yumen Petroleum Administration are successfully coping with this task.

From Yumen, we flew by way of Chiu-ch'uan, Lanchow and Sian to the city of Chengtu, the center of Szechwan Province. In Sian we visited the plant which produces modern geophysical equipment: complicated seismic prospecting, electrical coring, and electrical prospecting stations, magnetometers, and other apparatus. The plant uses the experience of the USSR and the other countries of the camp of socialism in its work. It should be said that although the enterprises of the People's Republic of China independently manufacture numerous types of new equipment used in various fields, part of the geophysical equipment is nevertheless obtained from the USSR and the other friendly countries, since requirements considerably exceed production capabilities.

Chengtu is located in Central China. The climate here is warm and very humid. The Szechwan depression, the resources of which include petroleum, is surrounded by mountains. The sedimentary rock stratum reaches 7 kilometers in depth. The cross section is complicated by dense rock. The structure is an upheaval with a slight angle of slope (2-3°) in the central part and a large angle of slope in the regions near the mountains. There are great regional and local (in the structures) dislocations.

The Szechwan depression region is quite favorable for using the seismic reflection method. In the central platform area reflection records are clear; these correlate well in considerable parts of the prospecting profile. Use of electrical prospecting in this region is quite difficult due to peciliarities of the geoelectrical cross section; the separate electrical resistivity of rocks (which is rather large on the average) gradually increases with depth. This case in principle is most difficult for the quantitative "layer" interpretation of the data of the electrical prospecting method of vertical sounding. Experimental work with the telluric current method in this region gave promising results.

The external physical geographical conditions of Szechwan Province turned out to be especially unfavorable for geophysical investigations. The presence of rice fields and a branching irrigation system makes it necessary to transport all the geophysical equipment by hand. The basic sections of the depression are relatively complicated, with a so-called small bald mountain relief: the bald mountains reach 100 meters in height and 500 meters in breadth; this greatly complicates the discovery of a structure with a small angle of inclination.

From Chengtu, we went to Nanking, where the petroleum geophysical expedition of the Ministry of Geology, People's Republic of China, conducting investigations in the sourthern part of the Northern China plain is located. An expedition operating out of Ch'an-chou city, which we visited during the first days after our arrival in the People's Republic of China, works in the northern part.

The plain is covered with a quaternary deposit up to 100 or more meters deep, and has been little studied from a geological point of view as yet. Within the plain are regional depressions and upheavals with sedimentary rock up to several kilometers deep. The physical geographical

conditions are unfavorable for conducting geophysical work due to an extensively branching water network and flooded rice fields. In many cases, especially in the southern part of the plain, the geophysical prospecting stations and equipment are carried by hand or are even located on boats, in which the members of the party also live. Such working conditions make it necessary to orient the lines of measurement along the curved lines of communication rather than along straight profiles assigned ahead of time; this greatly complicates interpretation of the observations. The example of the work in the Northern China plain makes very clear the need for the very rapid creation of portable geophysical apparatus. This technical problem, also of very real importance for work being conducted in the USSR (especially in Siberia), must be solved by the joint efforts of the two countries.

In the Northern China plain the geological geographical conditions are favorable for seismic and electrical prospecting. Conditions are good for exciting elastic waves, and the refraction borders are clear; in certain places there are rather good reflection records. However, in a number of cases there can be difficulties in connection with the recording, apparently, of multiple waves. There are great perspectives for the use of the vertical electrical sounding and the telluric current methods.

The development of scientific research work in electrical prospecting is especially important for China, since the territory of the People's Republic of China is huge and it is not possible to cover it by seismic prospecting, which is costly. Therefore, as a preliminary measure, work must be done with the cheaper magnetic prospecting, gravimetric and electrical prospecting methods, thus discovering the most likely sections for seismic prospecting and drilling.

The development of geophysical methods of prospecting in China was begun only a few years after the Liberation (until that time there were only three prospecting parties in the country). During a few years many geophysical parties were organized and they did a great amount of work in petroleum geology. At present there are 40-50 industrial seismic prospecting parties in the People's Republic of China, and as many electrical prospecting parties, with modern equipment.

However, a further increase in the number of parties, the development of new prospecting methods, and series production of the newest apparatus are needed.

We devoted the final period of our stay in the People's Republic of China to joint discussions with our Chinese friends, the geophysicists, of the results of the visits to the operating expeditions. Methodological problems common to a number of regions in the People's Republic of China and important physical and equipment problems which must be worked out by the geophysicists in the scientific research organizations, primarily in the Institute of Geophysics, Academy of Sciences, People's Republic of China, were noted. In doing this, consideration was taken of the fact that in the People's Republic of China, as in the USSR, scientific research work is closely connected with the solving of the most current national economic tasks. Therefore, the most important work must include: increasing accuracy and detail in seismic and electrical prospecting, especially in cases of studying structures with a small angle of slope in the presence

of small bald mountain relief, etc.; the investigation of structures with large angles of slope; the investigation and tracing of zones of dislocation and wedging out of layers; the study of the nature of changes in the lithological composition of the rock in a horizontal direction; investigation of the crystalline base with a study of the dislocations in it and of the relation of the structures in the base and in the sedimentary stratum; investigation of buried structures; the development of methods for the complex use of different seismic and electrical prospecting methods, etc.

The most important physical problems in the field of seismic prospecting must include: a study of the change in elastic waves, formed in steep sloping borders; a study of the change in multiple reflected and refracted elastic waves with the aim of distinguishing them on the seismograms; etc. In the field of electrical prospecting it is important to develop a new magnetic electrical method using variations of the earth's natural electrical magnetic field. It is necessary to investigate the p peculiarities of the different types of electrical and magnetic disturbances of the natural variations in the earth's electrical magnetic field with the purpose of selecting the most suitable observations for exact geological interpretation when prospecting by the telluric current method. The laws determining the electrical properties of rock must be clarified in consideration of the requirements for electrical coring. It is important to solve the task of seismic and electrical prospecting with models, to further develop the physical and mathematical bases of these methods, to work out methods for increasing the depth of electrical prospecting in a low-resistance section and in the case of the presence of high-resistance screening horizons. For example, for the work in Tsaidam, it would be desirable to study the sedimentary rock layer to a depth of 8-15 kilometers by the method of seismic and electrical prospecting. There are a number of quite important tasks connected with increasing the capability of solving problems and the economic effectiveness of the seismic and electrical prospecting methods.

All the problems listed are equally current for the People's Republic of China and for the USSR, and therefore it seems quite expedient for the academies of sciences of both countries to work on them jointly. Specific plans were worked out in great detail for scientific research in seismic and electrical prospecting by the Institute of Geophysics, Academy of Sciences, People's Republic of China, during 1959 and the following 5-7 years (with consideration given to solving the most current tasks).

FIGURE APPENDIX

Photograph, page 76

Seismic Prospecting Station of Chinese Manufacture in Yumen

Photograph, page 77

Entrance to the Building of the Institute of Geophysics, Academy of Sciences of the People's Republic of China, in Peking

5677

END